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SOME FEATURES OF IMPORTANT TAXA OF SOIL MESOFAUNA IN AN AFRO-MEDITERRANEAN COASTAL DESERT. IV.- SOIL FAUNA ASSOCIATED WITH *ANABASIS ARTICULATA*.

BY

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SUMMARY

The Omayed Biosphere Reserve is about 10x10 km in area, lying at 83 km west of Alexandria and 10 km south of the seashore. It belongs to the accentuated Arid Mediterranean climate, with about 90 mm rainfall / year, and calcareous soil admixtured with varying proportions of silica. An experiment of protection from grazing was carried out since 1974 with 4 plots of 0%, 25% and 50% of the grazing pressure prevailing in the surrounding area. The grazing animals are sheep and goats and the vegetation consists mainly of *Thymelaea hirsuta* and *Anabasis articulata* shrubs, with a num lber of other shrubs and herbs.

Within the framework of the SAMDENE and REMDENE research projects carried out in the Reserve for study and analysis of these desert ecosystems, samples of soil fauna associated with the main shrubs of the region were taken in the period 1980-1981 within the protected plots as well as from outside the fenced area. The present

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paper deals with the analysis of the populations of soil fauna sampled from under the shrub *Anabasis articulate* within the various plots of *different* grazing pressure, using the advanced techniques of correspondence analysis and ascending hierarchic classification. An attempt is made to relate certain species of soil fauna with the various environmental factors prevailing under such conditions.

INTRODUCTION

Understanding the patterns of abundance and distribution of soil invertebrates in various ecosystems has become possible through a number of major studies that have been ably summarized by Walloerk (1976). The number and such studies in desert ecosystems. however,. has not been on the same scale as in other more favured ecosystems due to the difficulties posed by the nature of the terrain. the looseness of the soil and the distibutional pattern of vegetation. Sampling soil fauna in deserts is made difficult by the extremely uneven spatial distribution of plants. Earlier studies on soil fauna in the Mediterranean desert of Egypt have shown that bare ground between the low desert shrubs is not a natural habitat for desert soil mesofauna. The overwhelming majority live in the litter /soil sùbsystem under shrubs. The term soil mesofauna in this and related studies refers to an arbitrarily chosen size group of soil invertebrates which do not pass through a 1-mm mesh size. Those that pass through this sieve are termed microfauna, while the term macrofauna is reserved to soil vertebrates.

– During a study on the effect of different degrees of grazing pressure on the structure of vegetation at the Omayed site (83 km west of Alexandria), within the scope of the SAMDENE Project (Ayyed and Ghabbour, 1977), it was possible to conduct a simultaneous studj on the effects of, these grazing pressures on the soil mesofauna.

Within the Reserve, a controlled grazineg experiment was carried out (Ayyad and El-Kadi, 1982 and Ayyad and Abdel-Razik. 1983). Three different degrees of grazing pressure (G. P.) within the fenced

area were 0%. 50% with perior protection for 3 years, and 50% without period protection. Sampling was made 3 years after setting up the controlled grazing experiment.

Studies on changes in soil fauna according to land use in Mariut region were reviewed by Ghabbour (1986) and El-Shishlny and Ghabbour (1988). The study clarifies the effect of land use on fauna, and that soil fauna are sensitive of the totality of environmental conditions prevailing in each land use type.

The purpose of the present study is to evaluate changes in populations of soil fauna due to the controlled grazing experiment, taking *Anabasis articulata* as example. The present paper is an elaboration of such studies. begun by Ghabbour and Hussein (1978) and Cancela da Fonseca *et al.* (1984) .

MATERIAL AND METHODS

The Study Area

It is 1ocated at about 83 km W of Alexandria and 10 km S of the seashore (29° 12. 15. E, 30 ° 45 N) (Fig. 1). The Reserve is located a non-saline depression between Gebel Mariut (3rd coastal ridge) and Gebel Khashm El-Aish (4 th coastal ridge), about 3 km S of Omayed village. Its landscape undulates between 43 and 75 m.a.m.s.l. and rises gradually southwards towards the 4th ridge (elevation 105 m). The soil is made of 1agoonal deposits composed of gypsum intermixed with sand and alluvium from erosion of the calcareous adjoining ridges . Surface soil layers are loose and subject to active erosion and derposition creating micro-topographic variations, but obelow 25 cm, soils are often compact. In some parts, surface layers include large amounts of snail fragments, increasing the compactness of the soil (El-Kadi 1980). The srea has been classified as part of the "Attenuated xero-Mediterranean climatic province of Egypt" (Ayyad *et al.* 1984). Mean annual rainfall between 1950 and

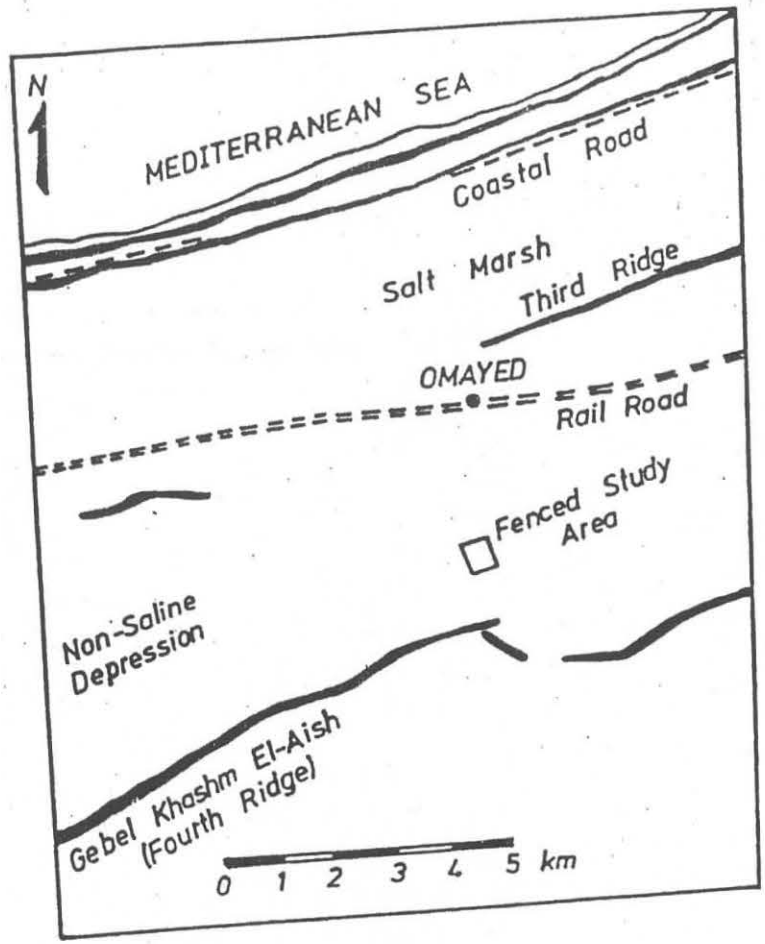

Fig 1 Map of the Omayed Biophere Reserve.

1964 was 160 mm, but the late seventies were prticularly dry. with rainfall varying between 50 and 110 mm/yr. In the period 1977-1979, mean air temperature varied from 13.6 to 27.2 °C. Mean surface soil temperatures vary From 13.8 to 32.0 °C, and mean soil temperatures at 10 cm depth vary from 12.8 to 29.6 °C. Mean air relative humidity varied From 56 to 87%. The vegetation is dominated by *Asphdelus microcarpus, Echiochilon fruticosum. Plantago albicans, Anabasis articulata and Atractylis carduus* (Abdel-Razik 1976). Other important species are *Thymelaea hlrsuta, Gymnocarpos decandrum* and Helianthemum lipii (El-Ksdi 1980).

The Grazing Management Experiment.

A plot 245x800 m (19.6 ha) wes fenced in August 1974 and completely protected from grazing. In May 1977, a part 175x800 m (14 ha) was separated and subjected to 50% grazing freely practiced outside the exclosure (100% grazing pressure). At the same date. two other plots, each of 14 ha, were also fenced. One was subjected to 50% G.P. and the other to 25% G. P. Thus the five treatments are:

To: free grazing outside the exclosure (100% G.P.), estimated recently at about 5.7 sheep units /10 ha (Ayyad and El-kadi 1982),

T1: three years of complete protection from grazing till 1977, followed by 50% G.P,

T2: complete protection since 1974.

T3: 50% G.P., preceded by free grazing (100% g.P.) as in To.

T4: 25% G.P., preceded by l00% G.P. as in To, both T3 and T4 started in 1977.

A map of the layout of the experimental plots is given by Ghabbour and Hussein (1978).

A flock of 10 animals was used (8 sheep and 2 goats) and was kept for 2 days in the 25% G.P. plot, and 4 days in each of the two 50% G.P. plots. The cycle was repeated at the end of each of the 10-days period (El-Kadi 1980). The estimation of G.P. in these plots was recalculated snd changed from 66 and 33% in earlier attempts (El-Ghonemy and El-Kadi 1978) to 50% and 25% respectively after more observations in the To area CAyvad and El-Kadi 1982) .

As a result of protection from grazing, there was an overall increase in density (about 200%) and cover (about 114%) of vegetation. Accordinc to Ayyad and El-Kadi (1982), between 1974 and 1979, the % change in cover of *Anabasis. articulate* shrub investigated here for its mesofaunal populations were as such:

To	T1	T2	T3
+75	+122	-41	-61

Sampling Soil MesoSauna

The method of sampling soil mesofauna was described by Ghabbour *et al*. (1977) snd Ghabbour and Hussein (1978). Briefly, this consists of digging the soil under the canopy of the shrub selected for sampling and passing it through 1-mm sieve, untill animals and litter are no longer obtained. A few extra sievings are passed through to ensure that the soil core under the canopy had been completely sampled . The diameter of the shrub and maximum depth abtained are then recorded. Selection of shrubs was at random. Since density of shrubs of any given species is very low, even if it increased with fencing, the number of shrubs to be sampled had to be kept at a minimum, to avoid undue destruction of the protected vegetation. Selection of sampled shrubs was by walking alone a trsnsect diagonally to the fence. The starting point was changed by to for egery sampling season. takinc care not to rePeat the same direction ln twó consecutive seasons. Six shrubs were sampled from the shrub species in each season, from leeward (L) and windward (w) sides. Treatments T3 and T4

were considered one (T3), since earlier work carried out in 1977-l978 proved they were very similar in their mesofaunal population densities (Ghabbour and Hussein, 1978). Ayyad and El-Kadi (1982) also found that vegetation responses were similar in these two treatments. Sampling was carried out once every season (July 1979, Sep. 1979. Dec. 1979, Mar. 1980 and Jul. i980). A total of 240 samples of *Anabasis* were thus taken, or 24 for each habitat type. for each season.

Soil Analysis

Soil samples from the surface and from 20 and 50 cm depth were collected for determination of soil moisture and soil organic matter (Jackson 1977).

Treatment of Data

The population density data of the various taxa of soil mesofauna found in the samples were treated by two methods: the Ascending Hierarchic Classification (AHC, Roux 1985) and Correspondence Analysis (CA) as developed by Benzecri (1973), Fenelon (1981) and Volle (1985). The first method serves to distinguish affinities and similarities between sites (or habitats), while the latter gives a varying 'weight' or inertia' to points in a 'cloud', as a messure of theirr dispersion. The first factorial axis expresses the largest possible portion of the total inertia in a straight line. The second axis expresses the maximum of the residual inertia at a right angle to the firest. Likewise, the third axis expresses the maximum of the remaining residual inertia at a right angle to the first two (three-dimensional), and so on. The proximity of points within a group is due to mutual attraction as well as to mutual repulsion from other group. The computer calculations for AHC sad CA were carried out at Cairo University using the DATAVISION programme 1.2 (Roux 1987) developed for Apple IIe in BASIC, and allowing for the application of the disjunctive coding method.

RESULTS

Table (1) shows results of soil moisture % at surface, -20 cm and -50 cm depth, organic matter % and litter weight. It is noticed that there is a great variability in the above mentioned variables both in the windward or leeward sides of the shrub and in the different treatments of grazing pressure. Table (2) shows the breakdown of soil mesofauns found under the windward side of *Anabasis* shrub. It shows that the main dominant species is the sand roach *Heterogamia syriaca*, which appeared in all seasons at all treatments with density ranging between 1.53 at T3 tratment during autumn season, and 16.63 at T1 treatment during summer season, with average of 8.32/m^2 . The averages of treatments of, this species were 12.98, 9.45, 4.6 and 6.22/m^2 for To, Tl, T2 and T3 respectively . This shows that the higher density recorded at (To) , the free grazing area, while the lower value belonged to (T2), the completelyprotected area. H. Syriaca was pollowed by *Messor* spp., antlions and spiders.

Table (3) shows the breakdown of soil mesofauna under the leeward side of *Anabasis* shrub. It also indicates that the same above sandroach was the dominant species, its density ranged between 2.98/m^2 at T2, the completely protected area during writer, and 37.21 at To, the free grazing area during spring, with average of 11.27/m^2 . The average of treatments of this species were 19.31, 13.24, 5.67 and 5.86/m^2 for To, T1, T2 and T3 respectively . Also, higher densities of this species occurred in To, while the lower density occurs at T2, and this species in followed by *Messor* spp., antlions and spiders as in the windward part.

Fig. (2) shows the graphic representation of applying the AHC and CA methods to the data of Tables (2) and (3). Here the complete protection treatment (T2) is distinguished clearly from the other different three treatments To, T1 and T3. The T2 treatment (o% G.P.) is

Table (1): Range and mean values of water content% at surface (WCS), water content% at-20cm depth (WCS), water (WCS), water content% at-50cm depth (WCS), organic matter% at surface (OMA) and litter weight (LWE) in grams, under different treatments of grazing pressure, for windward (W) and leeward (L) sides of Anabasis articulata n=5

		WCS	WC2	WC5	OMA	LWE
T0.W	range	0.98-3.28	0.64-7.50	1.45-8.47	0.21-0.34	217-665
	mean	1.95	3.40	3.84	0.26	413
L	range	0.91-4.35	0.53-5.21	1.46-2.75	0.20-0.37	331-661
	mean	1.83	3.19	2.53	0.31	462
T1,W	range	1.28-4.51	0.72-3.13	3.61-6.51	0.16-0.64	259-584
	mean	2.57	2.16	4.85	0.33	403
L	range	0.36-2.52	1.43-4.16	2.70-8.82	0.08-0.44	310-688
	mean	1.82	2.98	4.81	0.29	451
T2,W	range	0.92-2.24	0.97-2.09	1.40-6.55	0.30-0.54	273-352
	mean	1.53	1.11	3.339	0.39	314
L	range	1.11-2.75	0.98-3.16	0.75-4.88	0.25-0.68	359-592
	mean	1.77	2.11	2.55	0.47	474
T3,W	range	0.71-3.54	1.26-3.35	1.09-4.81	0.12-0.42	218-415
	mean	2.14	2.27	2.59	0.24	302
L	range	0.46-2.68	0.63-3.98	0.89-4.76	0.29-0.37	245-378
		1.95	2.34	2.42	0.33	315

Table (2): Breakdown of population density (PD/m^2) of soil mesofauna into species or higher taxa under different treatments of grazing pressure for *Anabasis articulata* W.

	T0					T1					T2					T3				
	Sum	Aut	Wit	Spr	sum	Sum	Aut	Wit	Spr	sum	Sum	Aut	Wit	Spr	sum	Sum	Aut	Wit	Spr	sum
ISO	0	0	0.90	3.35	0	1.19	0	3.13	0.95	0	0	0	0	1.78	0	0	0	2.20	1.35	0
THY	0	0	0	0	0.60	0	0	0	1.19	0	0	0.35	0.70	0.60	1.95	0.52	0	0.52	0	0
MAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ACR	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HET	8.95	15.59	12.79	16.04	11.56	16.63	9.46	8.14	7.07	0.95	6.99	3.28	3.51	2.00	7.33	7.05	1.53	4.46	4.14	13.93
PEN	0	0	0	0	0	3.46	0.52	0	0	0.76	16.15	2.76	0.74	0	0	0	0.52	0	0	0
CAP	0	1.12	0	0	0	0	0	0	0	0	0.43	0	0	0	0	0	0	0	0	0
HEM	0.43	0	0	0	0	0	0	0	0	0	0.52	0	0	0	0	0	0	0	0	0
ANT	0	1.28	0	0	0	0	0	3.76	2.55	2.0	0	5.17	6.65	4.86	7.33	0	0.52	0.92	1.79	0
DIP	0	1.44	0.43	0	0	0.76	0.43	0	0	0.76	0.88	1.22	0	0	1.52	1.19	0.52	0	0	0.76
CAM	0	0	0	8.93	0	0	0	0	0	2.27	0	0	0	0	0	0	0	0	0	0
MES	0	0	0	0.35	0	0.76	0	7.63	1.07	0	21.00	9.28	10.90	17.99	12.68	0	0	0	0.82	0
MON	0	0	0	0	0	0	0	0	0	0	0	0	0	0.48	0	0	0	0	0	0
CYM	0	0.90	0	0	0.60	0	0.33	0	0	0.94	0	0	0	0	0	0.52	1.20	0	0	2.04
SCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.62	0	0
GRA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRA	0	0	0	0	0	2.21	3.27	1.86	0.95	3.57	1.96	2.23	0.39	0	1.19	0	0.35	0	0	0
API	0	0	0	0	0.76	0	0.67	15.21	0.27	0.95	0.35	0.60	0	0.29	0	0	0.76	0	0	0
DEN	0	0	0	0	0	0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ERG	0	0.35	0.32	0	0	0	0	0	0	0	0	0.27	0	0	0	0	0	0	0	0
ERQ	0.38	0	0	0	0.60	0	0	0.48	0	0	0	0	0	2.14	0	0	0	0.52	0	0
MAC	0	0.69	0	0	0	0	0	0	0	0	0	0.95	0	0	0	0	0	0	0	0
PIM	0	0	0	0	0	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PSA	0	0	1.23	0.92	0	0	0	0.43	0	0	0	1.35	0.39	0	1.79	0	0	0	0	0
TEN	0.33	0.77	0.52	0.35	0	0.76	0.86	1.09	1.19	0	1.38	0	2.51	1.35	0	0	0	1.64	0.67	0
PSP	0	0.75	0.43	0	4.44	2.37	0	3.09	0.60	0.60	1.19	3.89	0	0	2.11	0.67	0.29	0.52	0	2.70
SCP	0	0	0	0	0	0	0	0.67	0	0	0	0	0	0	0	0	0	0	0	0
SCL	0.43	0.39	0	2.57	0.76	0	1.52	0	0.67	0.98	0	0	0.88	0	0	0	0	0.60	0	0
SAP	0	0	0.43	0	0	0	0	0	0	0	0.88	0.52	0	0	0	0	0	0	0	0
SPI	0.78	0.95	0.43	0	0.76	1.52	0.52	0	0	0	8.29	4.69	2.21	5.03	0	0	0	0	0	0.76
PSE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.60	0	0	0	0	0
TIC	0	0	0	0	0	0	0	0	0	0	0.67	0	0	0	0	0	0	0	0	0
GEO	0	0	0	0	0	0	0	0	0.60	0	0	0	0	0	0	0	0	0	0	0
SCO	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table (3): Breakdown of population density (PD/m^2) of soil mesofauna into species or higher taxa under different treatments of grazing pressure for *Anabasis articulata* L.

	T0					T1					T2					T3				
	Sum	Aut	Wit	Spr	sum	Sum	Aut	Wit	Spr	sum	Sum	Aut	Wit	Spr	sum	Sum	Aut	Wit	Spr	sum
ISO	0	0	4.08	2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0.84	0.74	0
THY	0	0.43	0	0	0	0	0	0	1.02	0	0	0	0.35	1.68	0	0	0	0	0	0
MAN	0	0.82	0	0	0	0	0	0.47	0	0	0	0	1.16	0	0	0	0	0	0	0
ACR	0	0	0	0	0	0	0	0	0	0	0	0.52	0	0	0	0	0	0	0	0
HET	12.20	15.78	11.35	37.21	20.03	20.47	17.34	8.07	12.88	7.44	10.21	4.83	2.98	6.10	4.22	8.14	3.45	12.85	3.03	6.78
PEN	0	0	0	0	0	5.08	0	1.93	0	1.43	4.34	3.38	1.17	0.67	0.60	0	0	0	0	0
CAP	0	0	0	0	0	0.43	0	0.52	0	0	0	0	0	0	0	0	0	0	0	0
HEM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANT	0.85	0	1.28	0.60	0	2.71	0.43	3.71	0.43	1.11	8.37	5.09	3.48	8.63	6.39	0.67	0	0	0	0
DIP	0	1.90	0	0.32	1.26	0	0.52	0	0.60	0.67	1.43	0.48	0.35	0.88	1.19	0.67	1.22	0	0.39	1.56
CAM	0	0	0	22.62	0	0	0	0	1.04	0	0	0	0.39	0	0	1.09	0	0.52	0	0.76
MES	0	0	0	0	0	0	0	11.45	0	0	14.60	8.93	10.65	24.85	22.69	0	0.82	0	0	0
MON	1.33	0	0	0	0	0	0	0	5.33	0	0	0	0	0	0	0	0	0	0	0
CYM	0	0	0	0	0.76	0.76	0	0	0	0	0	0.82	0	0	0	0	0	0	0	0
SCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.35	0	0	1.52
GRA	0	0	0	0	0	0	0	0	0	0	0	0	0	0.60	0	0	0	0	0	0
BRA	0	0.43	0	0	0.76	1.19	1.80	1.38	0.60	0	0	0	0.39	0	0	0	0	0	0	0
API	0	0	0	0	0	0	0	0	2.13	7.24	5.88	3.06	0.35	0	3.31	0	0	0	0	0
DEN	0	0	0	0	0	0	0	0	0	0	0.98	0	0	0	1.95	1.62	0.43	0	0	1.52
ERG	0.37	0	3.51	0.35	0	0	0.26	4.48	0	0	2.27	0.55	0	0	0	0	0	0	0	0
ERQ	0	0	0	0	0	0	0	2.47	0	0	0	0	1.51	0.60	0	0	0	0	0	0
MAC	0	0.27	0	0	0	0	0	2.08	0	0.67	0.88	0	0	0	0	0	0	0	0	0
PIM	0	0	0	0	0	0.43	0.43	3.14	0	0.60	0.86	0.48	0.48	0	0	0	0	0.32	0	0
PSA	0	0	1.53	0.19	0	0	0	0	0.43	0	0.88	0	0	0	0	0.35	1.68	0	0	0
TEN	0.73	0.77	0.40	0.60	0	1.19	0.86	0	0.43	0	0.43	0.43	0.39	0	0	1.56	0	0	0	0
PSP	0.36	0	0.28	0	1.65	1.19	0	1.71	0.52	0	0.43	2.60	3.50	0	3.31	0	0	0	0.76	0
SCP	0	0	0	0	0	3.13	0	2.00	0	4.29	0	1.83	1.34	0	0	0.43	1.16	0.76	1.28	0
SCL	0.33	0.43	0.39	2.57	0	0	0	0	0	0	0	0	0	0	1.35	0	0.72	0	0	0
SAP	0.36	0	0	0	0	0	0	0.67	1.02	0	1.09	0.27	0	0.88	0	0.52	0	0	0	0
SPI	0.78	0.77	0	0	0	0.43	0	0	0	0	0	0.55	0	0	0	0	0	0	2.48	0
PSE	0	0	0	0	0	5.41	0.85	0.59	0	0	14.21	5.17	3.92	5.11	7.47	0	0	0	0.39	0
TIC	0	0	0	0	0	0	0	0	0	0	1.09	0	0	0	0	0	0	0	0.36	0
GEO	0	0	0	0	0	0	0	0	0	0	0	0.43	0	0	0	0	0	0	0	0
SCO	0	0	0	0	0	0.76	0.16	0.67	0.60	0	0	0	0	0.88	0	0	0	0	0	0
								0	0	0	0	0.48	0	0	0	0	0	0	0	0

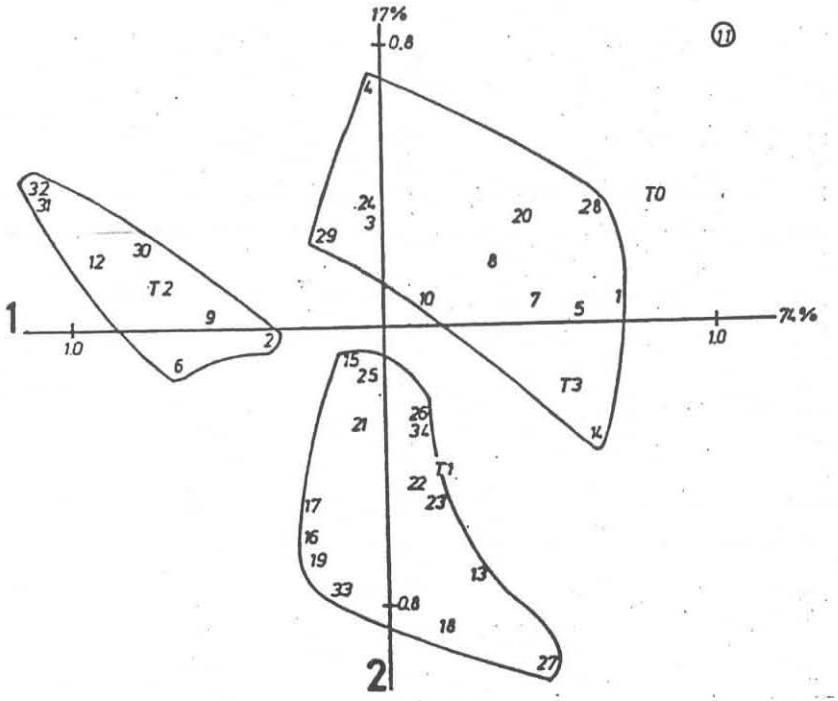

Fig 2 Grphic representation of the results of ordination by the CA method with the result of groupings by AHC method of the data of poulation densities of soil mesofauna under *Anabasis* shrub shown in Tables (2 and 3) by disjunctive coding. Symols: T0. T2 and T3 are the different treatments of grazing pressure. numbring of taxa (1- 34) as in Appenix. In this and in subsequent figures of ordination 1 and 2 at 3 ends of the axes represent the first and second axes the percentage at the ends of the axes represent their relative contributions to the ordination. while the figures giving the scale of the axes in their appropriate places.

characterised by pentatomidae, Thysanura, antlions, spiders, Pseudoscorpions, *Messor* spp. and Ticks. T1 treatment (three years of complete protection from grazing till 1977, followed by 50% G.P.) is characterised by *Scarites buparius*, Tenebrionidae larvae, Psammobius *porcicollis, Erodius quadrileneata*, Scorpion, *Machlopsis crenatocostata, Pimelia spp., Brachycerus spinicollis, Graphopterus* serrator *Dendarus piceus, Geophilus* spp., *Monomorium* spp. , *Apion* spp. and Scarabaeidae pupae. The other two treatments, To and T3 are intermingled with each other and characterised by the rest of species. Here it is difficult to distiguish between the last two treatments (To and T3). Also, the effect of shrub direction and seasonality did not appear in this application.

In order to clarify the picture, the data of the mean population density of each treatment for both windward and leeward sides of the shrub (calculated from Tables 2 and 3) were treated by AHC and CA methods (Fig.3). Here the completely protected area (T2) is distinguished from the other three treatments. and characterised by ticks, Pseudoscorpions Apion spp., *Messor spp.*, spiders, Thysanura, antlions and Pentatomidae while the other three treatments (To, T1 and T3) are grouped together and characterised by several species. These species are Scarabaeidae larvae, Acrididae, Isopoda, *Erodius gibbus,* Mantidae, *Psammoica lucida, Saprinus* spp., *Scarites buparius, Heterogamia syriace,* Diptera larvae, Hemiptera, Tenebrionidae larvae, *Capsodes* spp., *Psammobius porcicollis, Cymindis suturalis, Erodius quadrilneata,* Scarabaeidae pupae, *Machlopsis crenatocostata* and *Monomorium* spp. It is noticed that the two sides of the shrub are closely related to each other in each treatment. H. *syriaca* occupied a position intermediate between the free grazing area (To) and T3 (100.% grazing followed by 50% G.P). *Brachycerus spinicollis, Geophilus* spp., *Dendarus piceus* and *Graphopterus serrator* appeared to be intermediate species between the complete protection treatment and the other three treatments.

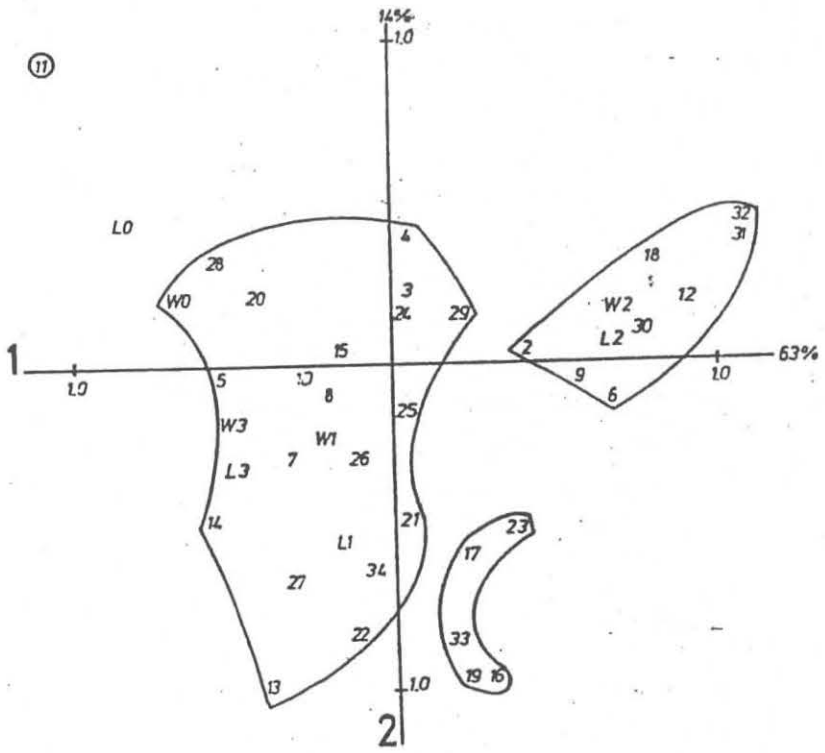

Fig 3 Graphic representation of the results of ordination by the CA method with the result of groupings by AHC method of data of the mean density obtained from Tables (2 and 3) . symbols: L= Leeward. W= windward. large numbers (0-3) are symbols of treatments as in Fig (2) .

Fig. (4) shows the graphic repesentation of applying AHC and CA methods for population densities of species versus environmental factors for all treatments and seasons. Each of the environmental factors was classified into two levels by the method of disjunctive coding low and high: then population density of each species is distributed a acording to these two levels. It is noticed that the horizontal axis represents about 83% of the inertia and three factors were distributed along this axis. These factors are soil moisture % at surface and at 20 cm depth and organic matter %. Higher levels of soil moisture % at surface and 20 cm depth and low level of organic matter % are present in one side of the figure, and characterised by the presence of *Capsodes spp., Monomorium* spp. , *Camponotus* spp., *Scorpion-, Erodius gibbus, Dendarus piceus, Graphopterus serrator* and Mantidae. Low evels of soil moisture % at surface and 20 cm depths with high level of organic matter aer in the opposite side of the figure, and characterised by *Apion* spp., Pentatomidae, Ticks, antlions, *Pimelia* spp., Spiders and Pseudoscorpions. The other two Factors; soil moisture % at 50 cm depth and litter weight appear to be distributed along the longitudinal axis (12%') of the inertia. The species which are favoured by these condition are Diptera larvae, Tenebrionidae larvae. *Erodius quadrileneata, Brachycerus spinicollis,_Saprinus* spp., *Heterogamia syriaca,* Scarabaeidae larvae, *Machlopsis_crenatocostata, Geophilus* spp., Psammoica lucida , Acrididae, Hemiptera, Cymindis suturatis, Isopoda and *Scarites buparius*. Also , it is noticed that Scarabaeidae pupae are not affected by any of these factors.

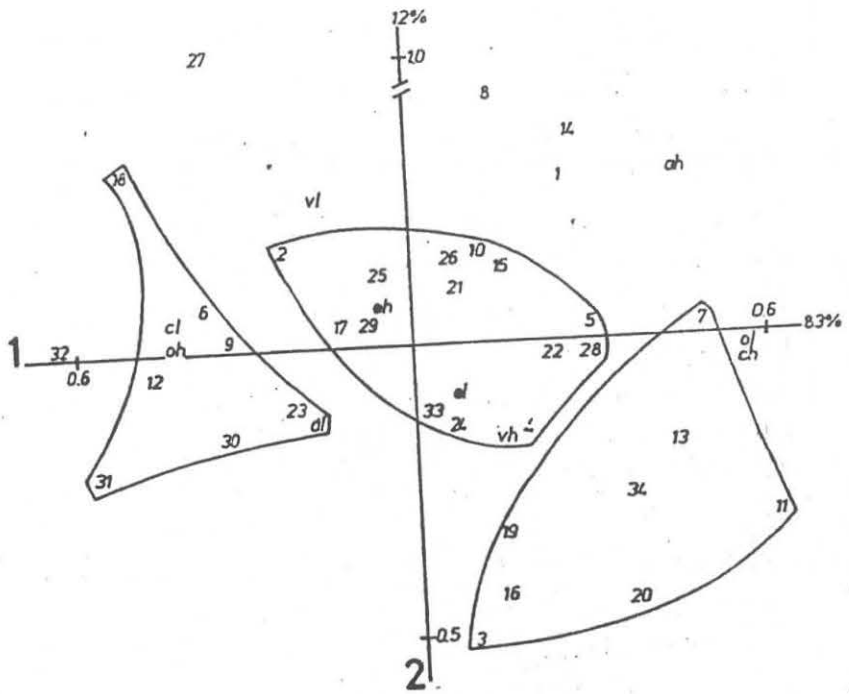

Fig 4 Graphic representation of the results of ordination by CA method with results of groupings by AHC method to the data of Tables (1.2 and 3) using disjunctive coding symbols: a = soil moisyure at surface. c = soil moisture at 20 cm depth, e= soil moisture at 5- cm depth. 0 = organic matter and v =litter weight. while l = lower level and h = higher level.

DISCUSSION

It is clearly noticed that, the sandroach *H. syriaca* is associated with the free grazing area (To) . This taxon may be affected to a great extent by higher soil moisture at surface and at 20 cm depth, a higher litter weight and a lower organic matter %. This may be due to the effect of continuous trampling by grazing animals, leading to the prevention of soil crust formation. On the other hand, it is noticed that *Messor* spp.; the harvester ant is associated with the complete protected area (T2) with spiders and antlions. Also, associated with it, are the herbivore Pentatomidae and Thysanura, which feed on the litter of graminae especially that of *Cutandia* sp. which has very selender leaves. This group is associated with higher organic matter % as a result of protection and lower percentage of soil moisture at surface and at 20 cm depth. The lower soil moistures are probably due to the presence of soil crust as well a the increased plant biomass which results in higher transpiration rates.

The presence of taxa associated with the two intermediate treatments in the middle of the diagrams superimposed upon points of lower and higher levels of soil moisture % at 50 cm depth, does not mean that these taxe are necessarily related to soil moisture at 50 cm depth, because variations of soilure at these depths are not great of soil moisture at surface = 0.7, at 20 cm depth = 0.7, and at 50 cm depth = 1.1). As regards litter weight, the lower values are associated with complete protection. This is not surprising because most of this litter is made up of leaves of light weight which are rather easily decomposable and contribute to a higher percentage of soil organic matter. On the other hand, litter of the free grazing area is mostly made up of woody material of heavier weight and not easily decomposable, cotributing very little to the formation of soil organic matter.

It is apparent that protection tends to replace the dominants of detritivores species by herbivores and granivore species. A group of carnivores (antlions, spiders, ticks, Pseudoscorpions) seems to be more abundant with herbivores and granivores.

Problems of population ecology of soil fauna under various treatments of grazing management appear to need further study in order to understand better the behaviour of these animals in such treatments.

Tile application of disjunctive coding method to the data set before applying the CA treatment, in order to better understand the relationships of animal taxa with environmental factors, is necessary because of the heterogeneous nature of the data (several units of measurements). This kind of mathematical treatment has further a numbner of important features of which these two are especially noteworthy:

1- It reduces the effect of eccentric values in the data set, and thus helps to givegeneralised view of their totality not affected by exceptionally high (or low) values of taxa, caused by aggregation more seriously density (frequent under desert condition), or by the obligation to limit the size of' samples (due to the scarcity of shrubs available for sampling in the experimental plots), or to exceptionally high (or low) measurements of environmental factors. The result of this reduction of the effect of eccentric values is to sharpen the more important trends in relationships. and in vcreasing the contribution of, non-eccentric values of, the data set. This is refelected in the increase of the contributions of the first and second axes at the expense of the contributions of the other axes.

2- The other and more important feature, from the point of view of synecological studies, is that this mathematical treatment allows us non-linear relationships betwees taxa and envronmental factors. In ordinary CA, relationships between taxa and environmental factors are treated and simple correlation coefficients are calculated between

each taxon and each factor In such a case, a low correlation coefficients will imply the absence of relationship (independence) between the two variables. This would be misleading , because in ecology , and in desert ecology more particularly, this may not be the case, since many relationships could be non-linear.

Dsjunctive coding before the CA treatment allows us to discover non-linear relationships between variables, if they exist (Bouroche and Sporta 1983), e.g., in case of, parabolic, step-wise, or inverse relationships, not infrequent in ecology .This requires from the ecological investigator an intelligent choice and testing of various numbers and limits of modalities into which the date are to be divided, backed by his field experience and knowledge, so tha the actual role of each environmental factor with its variou modalities (categories), in the distributioni tribution of each taxo, can be examined and revealed. The combination of several modalities and their interactions (e.g high and vice versa), and also be examined temperature and low humidity, their effects on taxa, can also be examined and revealed in the same way. Several computer runs with these opportunities will be needed for this prpose, and this is adequately provided for by the DATAVISION programme, which thus becomes very helpful in attaining this objective, which represents a fundamental goal in synecological research.

ACKNOWKEDGEMENTS

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REFERENCES

Abdel-Razik, M. S. (1976) A study on the vegetaion composition, productivity and phenology in a Mediterranean desert ecosystems at Omayed (Egypt). M.Sc Thesis, Univ. of Alexandria .

Ayyad, M.A. and Abdel-Razik, M.S. (1983) An analysis of the vegetation composition under different grazing treatments in a Mediterranean desert ecosystem (Egypt). REMDENE, UNESCO, Acad. Sci. Res . & Tech., Cairo :22 pp.

Ayyad, M.A. Abdel-Razik, M. and Mehanna, A. (1984) Climatic and vegetational gradients in the Mediterranean desert of Egypt. *Actualities* Bot. 131:129-143.

Ayyad, M.A. and El-Kadi H.F. (1982) Effect of porotection and controlled grazing on the vegetation of a Mediterranean desert ecosystem in northern Egypt. *Vegetatio* a 49: 129-139.

Ayyad, M.A. and Ghebbour, S.I. (1977) Systems Analysis of Mediterranean Desert Ecosystems of Northern Egypt (SAMDENE). *Environm, Conserv.* 4 : 91-101.

Benzecri, J.P.(1973) *L'analyse des Donnees.* Dunod, Paris .

Bouroche, J.-M. and Saporta, G. (1983) *L'Analyse des donnees.* 2nd ed. P.V.F., Paris: 127 pp.

Cancela da Fonseca, J.P.; Ghabbour, S.I. and Hussein A.M. (1984) Characterization of soil mesofauna in a xero-Mediterranean ecosystem after a 3-year grazing management. *Ecol. Mediterr.* 10: 121131.

El-Ghonemy, A.and El-Kadl, H.F. (1978) Range experiment. *SAMDENE Progress Report* No. 4. Vol 1, ch. 10: 20. pp.

El-Kadl, H.F.(1980) *Effects of grazing pressures and certain ecological parameters on some fodder plants of the Mediterranean coast of Egypt.* M.Sc. Thesis, Univ. of Alexandria.

El-Shishing, H. and Ghabbour, S.I. (1988) Environmental site characterization by soil fauna in Egypt and Afries. J.Afr. Zool. 102:333-345.

Fenelpn, J.P. (1981) *Qu`est-ce Qu l'Analyse des Donnees* / Lefonen, Paris: 311 PP.

Ghabbour, S.I.(1986) Effect of Land Use on Soil Fauna, *Final Reports . IARS/UNESCO* Project 210125/5. JARS, Cairo Univ., Cairo: 45 pp. (typoscript).

Ghabbour, S.I. and Huesein, A.M. (1972) Effect of a oneyear grazing management on population densities of soil fauna in an AfroMediterranean desert ecosystem. *Cairo Univ. Afr. Stud. Rev.* 7 (1978): 55-75.

Ghabbour, S.I.; Mikhail, W.Z.A. and Rizk, M.A. (1977) Ecology of soil fauna or Mediterranean desert ecosystems in Egypt.

I. Summer population of soil mesofauna associated with major shrub" in the littoral sand dunes. *Rev Ecol. Biol. Sol* 14: 429-459.

Jackson,M.L. (1977) *Soil chemical analysis.* Prentice-Hall of India Private, New Delhi: 270 PP.

Roux, M. (1985) *Algorithem de Classification* Masson. Paris : 151 pp.

Roux, M. (1987) *DATAVISION 1.2, logiciel danalyse des donnees.* CEPE/CNRS, Montpellier: 30 pp.

Volle, M. (1985) Analyse des Donneés. 3 rd ea., Economics, Paris 324 pp.

Wallwork, J.A. (1976) The Distribution and Diversity of Soil Fauna. Acad. Press, London: 355 pp.

Appendix : Taxon List

No	SYM	Name
1	ISO	Isopoda
2	THY	Tysanura
3	MAN	Mantidae
4	ACR	Acrididae
5	HET	*Heterogamia syriace*
6	PEN	Pentatomidae
7	CAP	*Capsodes* sp.
8	HEM	Hemiptera
9	ANT	Antlions
10	DIP	Diptera larvae
11	CAM	*Camponotus* sp.
12	MES	*Messor* sp.
13	MON	*Monomorium* sp.
14	CYM	*Cymindis suturalis*
15	SCA	*Scarites buparius*
16	GRA	*Graphopterus serrator*
17	BRA	*Brachycerus spincollis*
18	API	*Apion sp.*
19	DEN	*Dendarus piceus*
20	ERG	*Erodius gibbus*
21	ERQ	*Erodius quadrileneata*
22	MAC	*Machlopsis crenatocoststs*
23	PIM	*Pimelia Sp.*
24	PSA	*Psammoica lucida*
25	TEN	Tenbrionidae larvae
26	PSP	*Psammobius porcicollis*
27	SCP	Scarabaeidae pupa
28	SCL	Scarabaeidae larvae
29	SAP	*Saprinus sp.*
30	SPL	Spiders
31	PSE	Pseudoscorpions
32	TIC	Ticks
33	GEO	*Geophilus* sp.
34	SCO	Scorpions

بعض مظاهر الأنواع الهامة من حيوانات التربة في صحراء ساحلية أفرومتوسطية

٤ - عشائر حيوانات التربة المرتبطة بنبات العجرم

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ملخص

أجريت هذه الدراسة فى محمية العميد للمحيط الحيوى ومساحتها ١٠×١٠ كم وتقع على مسافة ٨٣ كم غرب الأسكندرية ، ١٠ كم جنوب الشاطى، وتتبع نظام المناخ المتوسطى الجاف الصحراوى . حيث لا يزيد متوسط المطر عن ٩٠ مم سنويا وتربتها جيرية مختلطة بنسب متفاوتة من السيليكا. والنبات السائد هى شجيرات المتنان والعجرم مع بعض الأنواع الأخرى، وحيوانات الرعى هى الخراف والماعز. وقد أجريت تجربة لحماية الغطاء النباتى من الرعى الجائر منذ عام ١٩٧٤ بتحديد ٤ قطع منع فيها الراعى بنسب صفر و ٢٥ و ٥٠ و ١٠٠ ٪ من المعدل الخارجى. وقد أخذت عينات من حيوانات التربة المرتبطة بالشجيرات السائدة على مدى خمسة فصول متتالية من أسفل هذه الشجيرات لمدة أكثر من عام من القطع المحمية وكذلك من خارجها. وتتناول الورقة هنا تحليل البينات التى توفرت من الدراسة عن عشائر حيوانات التربة التى جمعت من أسفل شجيرات العجرم فى القطع المختلفة والمعرضة لضغوط رعى متفاوتة فى الشدة، باستخدام الأساليب الأحصائية المتقدمة من التحليل التوافقى للعوامل والتصنيف الهيراركى التصاعدى. وأجريت محاولة للربط بين الأنواع الهامة من حيوانات التربة التى جمعت، وبين مختلف العوامل البيئية السائدة فى المنطقة تحت الظروف الموجودة على مدار العام.